Detailed description of the drawings

Figure 1 represent a preferred embodiment of the apparatus according to the invention. In the Figure a reactor riser (1) of a fluidized catalytic cracking process is shown which is fluidly connected via conduit (2) to a primary cyclone (3). In the Figure only one primary cyclone separator is shown for clarity reasons. Typically more than one, suitably two or three, primary cyclone separators (3) will be in fluid communication with the down stream end of a reactor riser (1). The primary cyclone (3) has a tubular housing (4) consisting of a tubular wall section (5) provided with a tangentially arranged inlet (6) for receiving the suspension of catalyst particles and hydrocarbon vapour which leave the reactor riser (1). The inlet can have for example a circular or rectangular form. The lower end of the tubular wall section (5) is fluidly connected by means of a frusto conical wall section (7) to a dipleg (8). Through dipleg (8) most of the catalyst particles will be discharged downwards. The upper end of the tubular wall section (5) is provided with a, suitably flat, cover (9). Cover (9) is provided with an axial circular opening (10) which opening serves as a gas inlet opening of a gas outlet conduit (11). The beginning of the gas outlet conduit (11) is suitably arranged perpendicular relative to the cover (9) and has the same axis as the axis of tubular housing (4). The diameter of the gas inlet opening of the gas outlet conduit (11) is preferably between 0.3 and 0.6 times the diameter of the tubular wall section (5) of the cyclone housing (4). Essential to the present invention is that the gas outlet conduit (11) does not, or not significantly, protrudes the cyclone housing from above. In a possible embodiment of the present invention a small protrusion is allowed. Preferably such protrusion is

smaller than 0.5 times the diameter of the gas inlet opening or axial circular opening (10) in the cover (9) of the cyclone. The gas outlet conduit (11) is in fluid communication with a secondary gas-solids separator (12). In the Figure only one secondary separator is shown for clarity reasons. In a typical arrangement more than one, suitably two, secondary separators (12) are in fluid communication with the gas outlet conduit (11) of one primary cyclone (3). The secondary separator (12) shown in the Figure is a typical conventional cyclone separator as described in the afore mentioned general textbook having a tangentially arranged gas inlet and a gas outlet conduit (13) which protrudes the roof (14) of the tubular cyclone housing (15). Through this gas outlet conduit the hydrocarbon vapours which are poor in catalyst particles are discharged from the apparatus according the invention. The vapours are further processed in downstream product separation equipment (not shown). The secondary cyclone (12) is further provided with a dipleg (16) fluidly connected to tubular housing (15) to discharge separated catalyst particles downwards.

Preferably the gas inlet opening of the gas outlet conduit (11) of primary cyclone (3) is located at a distance (d1) above the centre of the tangentially arranged inlet opening (6), which is greater than any typical values for the state of the art cyclones having a protruding gas outlet conduit. More preferably the ratio of this distance (d1) and the diameter (d2) of the tubular housing (4) is between 0.2 and 3 and most preferably between 0.5 and 1.5. In the illustrated embodiment the gas inlet opening of the gas outlet conduit (11) is flush with the cyclone cover (9).

Figure 1 without a riser (1) illustrates an apparatus according to the invention which can be used in other

separation applications, for example is an FCC regenerator.

Preferably an FCC regenerator will be provided with a plurality of primary and secondary cyclones as illustrated in the upper part of the regenerator vessel. A short conduit will fluidly connect the interior of the regenerator vessel and the tangentially arranged inlet (6).

Figure 2 represents a preferred embodiment of the apparatus according to the invention. Figure 2 illustrates a fluidized catalytic cracking (FCC) reactor vessel (26) comprising the upper part of a reactor riser (27), a primary cyclone (30) and a secondary cyclone (36). The downstream end of the reactor riser (27) is in fluid communication with the tangentially arranged inlet (29) of the primary cyclone (30). More than one primary cyclone (30) may be connected to the riser outlet and more than one secondary cyclone (36) may be connected to one primary cyclone(30). For clarity reasons only one primary cyclone (30) connected to one secondary cyclone (36) is shown.

The reactor vessel (26) further comprises at its lower end a stripping zone provided with means (31) to supply a stripping medium to a dense fluidized bed (32) of separated catalyst particles. Stripping medium can be any inert gas, steam or steam containing gasses are suitably used as stripping medium.

The reactor vessel (26) further comprises means to discharge stripped catalyst particles from the vessel via conduit (33). Via conduit (33) stripped, or also referred to as spent catalyst, is transported to a regeneration zone (not shown). In such a regeneration zone coke is removed from the catalyst by means of (partial) combustion. Regenerated catalyst is transported to the upstream part of the reactor riser where it is contacted